Using EPA Superfund PRG Calculators for RAL and RDD/IND Situations

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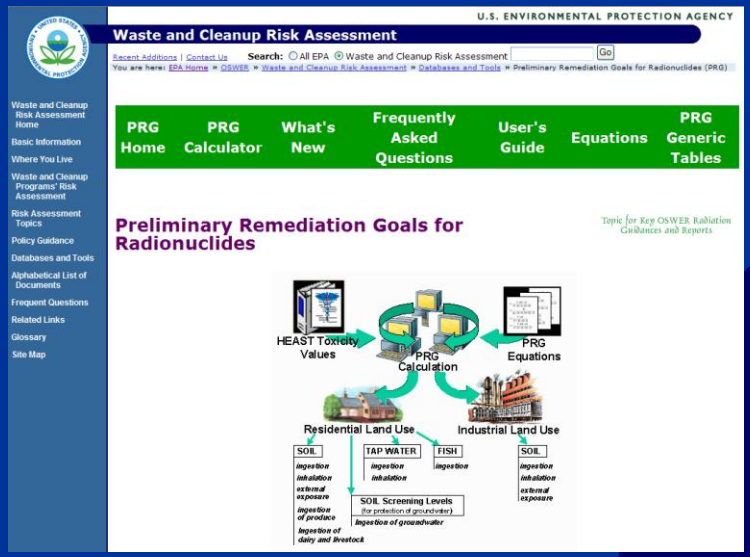
Session on RDD and other Nuclear Weapons
WM 2011 Symposia
in Phoenix, AZ on March 2, 2011

EPA

Purpose

- Provide overview of Preliminary Remediation Goal (PRG) and Dose Compliance Concentration (DCC) calculators
- Describe how PRG calculators may be used for RALs
- Describe how PRG and DCC calculators may be used for RDDs and INDs during late-phase under DHS PAGs



1. PRG and DCC calculator overview

CERCLA standards & policies

- Where ARARs are not available or protective, EPA sets site-specific cleanup levels that:
  - For carcinogens, represent an increased cancer risk of 1×10^{-6} to 1×10^{-4}
    - 10^{-6} used as "point of departure"
- Dose assessment ***only*** for ARAR compliance
- TBC's (including concentration recommendations) should be used only if protective under CERCLA
  - within 10^{-6} to 10^{-4} using CERCLA risk assessment methodology

CERCLA Risk and Dose Calculators

Human Health

Cancer risk (1 x 10^{-6})

- PRG (soil, water and air)
- BPRG (inside buildings)
- SPRG (outside surfaces)

Dose (millirem per year)

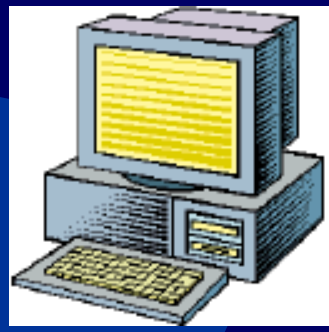
- DCC (soil, water and air)
- BDCC (inside buildings
- SDCC (outside surfaces)

Ecological

- *REB (aquatic, riparian, terresterial, plants and animals*

Guidance: Rad PRG Calculator

- Calculator to establish PRGs, when:
  - » ARAR is either not available or sufficiently protective (e.g., 25 mrem/yr [0.25 mSv/yr] or more)
- Electronic equations (risk and leaching to groundwater) also are on Internet
  - » $1x10^{-6}$ and MCLs (leaching from soil)
  - » Accounts for technical differences of radiation (e.g., gamma, plant uptake)



Guidance: Rad PRG Calculator (continued)

- Seven scenarios/land uses available

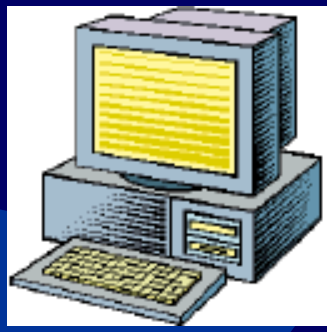
1. Residential
2. Agricultural
3. Indoor workers
4. Outdoor workers
5. Composite workers
6. Fish ingestion
7. Tap water
8. Soil to groundwater

- Chemical SSL Internet equations should be used for chemical toxicity of uranium
- EPA developed Internet-based training with States (ITRC) on calculator and radiation risk assessment
  - » http://www.clu-in.org/conf/itrc/rads_051507/

Guidance: ARAR Dose Calculator

- Calculator to establish Dose Compliance Concentrations (DCC) for single dose limit ARARs requiring a dose assessment
- Six scenarios/land uses available

1. Residential
2. Agricultural
3. Indoor workers
4. Outdoor workers
5. Composite workers
6. Fish ingestion
7. Tap water
8. Soil to Groundwater



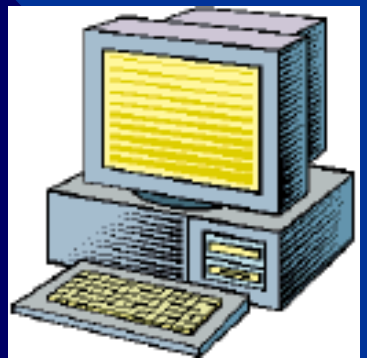
- Equations similar to those used for PRG calculator, except dose conversion factors used instead of slope factors

EPA/ITRC Radiation Risk Training

- Four modules provide:
  1. Background and Regulatory Case Studies
  2. Existing Practices in Radiation Risk Assessment
  3. **Use of Radiation PRG Calculator *(tutorial on using PRG and ARAR dose calculator)***
  4. **Case Study Application for PRG Calculator**

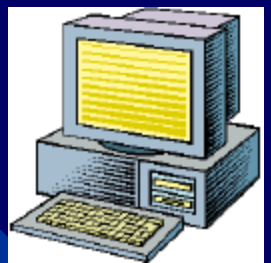
EPA/ITRC Radiation Risk Training, cont.

- Eight Live Internet rad CERCLA Policy Training sessions have been conducted
  - » 1,047 total participants, including 165 EPA employees
- An archived version of a live training session is available at:
  - » http://www.clu-in.org/conf/itrc/rads_051507/
- Archived version was accessed by users 1,710 times between January 1, 2008 and August 26, 2009.



Guidance: Building PRG (BPRG) Calculator

- Calculator to establish $1x10^{-6}$ risk based PRGs for the reuse of radioactively contaminated buildings.
- Equations and parameters are derived from latest EPA chemical methodology (e.g., assessment at WTC)
  - » Adjusted to account for technical differences posed by radiation
- EPA and ITRC Internet-based training on BPRG calculator and D&D
  - » http://www.clu-in.org/conf/itrc/radsdd_040308/



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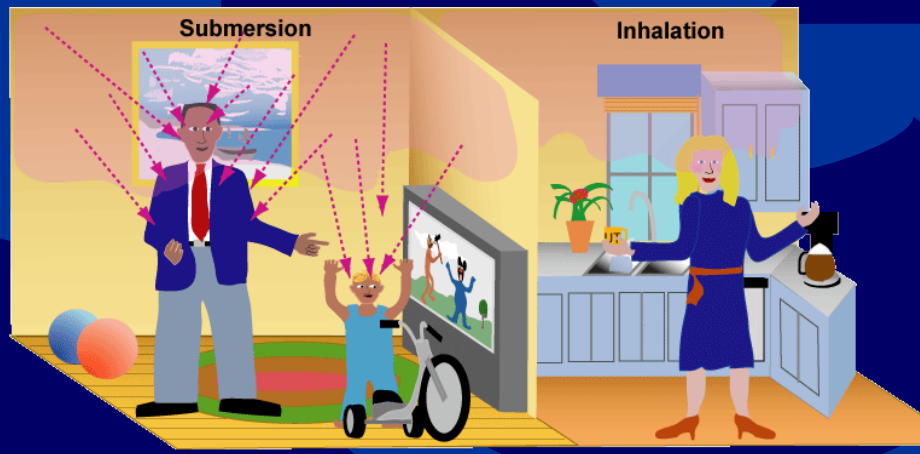
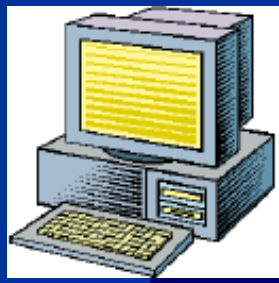
Guidance: Building PRG (BPRG) Calculator (continued)

- BPRG calculator includes 2 land use scenarios
  - » Residential
  - » Indoor worker
- Both land uses include 3 exposure routes
  - » Settled dust
  - » Ambient air
  - » Direct external exposure
    - —5 Room sizes and 4 receptor locations, both
      - –Surface
      - –Volumetric



Building Dose Cleanup Concentrations (BDCC) ARAR Dose Calculator

- BDCC Purpose: to establish BCCs for Inside Buildings for single dose limit ARARs (# mrem/yr)
- BDCC includes 2 land use scenarios (Residential, Indoor Worker)
- 2 land uses include 3 exposure routes (Settled dust, Fixed Direct External 3-D, Ambient Air)
- Equations similar to those used for BPRG calculator, except dose conversion factors used instead of slope factors



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Surfaces PRG (SPRG) Calculator

- Establish 1 x 10^{-6} risk based PRGs for radioactively contaminated ***outside*** hard surfaces (e.g., slabs, pavement, sidewalks, sides of buildings)
- Derived from rad PRG and BPRG calculators

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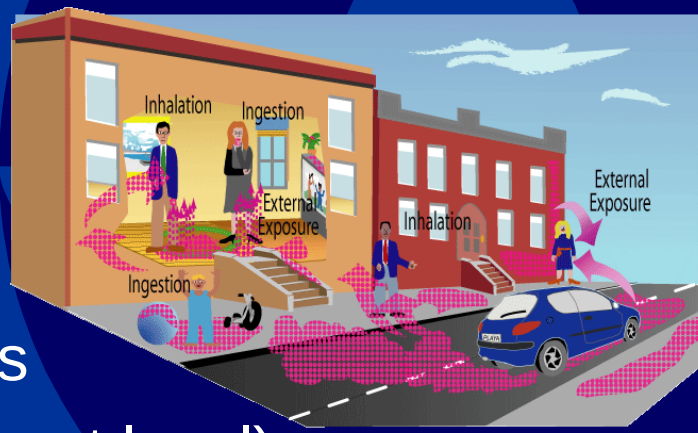
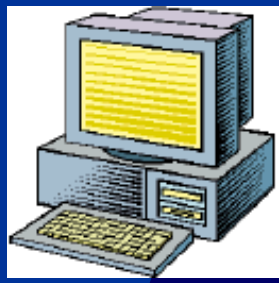
SPRG Exposure Scenarios

- SPRG includes 3 land use scenarios
  - » Residential
  - » Indoor Worker
  - » Outdoor Worker
- 3 land uses include 3 exposure routes
  - » Settled dust (pave and unpaved street level)
  - » Fixed Direct External 3-D (street level)
    - —Surface and Volumetric
  - » Fixed Direct External 2-D (slabs)
    - —Surface and Volumetric



Surface Dose Cleanup Concentrations (SDCC) ARAR Dose Calculator

- SDCC Purpose: to establish DCCs for Outside Hard Surfaces for single dose limit ARARs (# mrem/yr)
- SDCC includes 3 land use scenarios (Residential, Indoor Worker, Outdoor Worker)
- 3 land uses include 3 exposure routes (Settled dust, Fixed Direct External 3-D, Fixed Direct External 2-D (slabs))
- Equations similar to those used for SPRG calculator, except dose conversion factors used instead of slope factors



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EPA/ITRC Radiation D&D Training

- Four modules provide:
  1. Introduction and Regulatory Basis for D&D
  2. Factors for Implementing D&D
  3. **Preliminary Remediation Goal (PRG) Calculators *(tutorial on using BPRG, SPRG, BDCC, and SDCC calculators)***
  4. Case Studies and Lessons Learned

2. Using PRG calculators for RALs

RAL Approach

- Risk-based Removal Action Levels (RALs) for carcinogens generally are based on a 1×10^{-4} cancer risk.
  - » Not 1 x 10^{-6} like PRGs
- RALs typically are used to help define areas, contaminants and conditions that may warrant an emergency or a time-critical removal action at a site.

Using PRG Calculators for RALs

- To develop RALs based on the PRG calculator, either

1. multiply the PRG results from either the tables on the PRG "Download" page or the default option for the PRG "Search" page by 100; or,
2. select the site-specific on the PRG "Search" page and change the TR (target cancer risk) from 1.0E-6 to 1.0E-4.

Guidance language

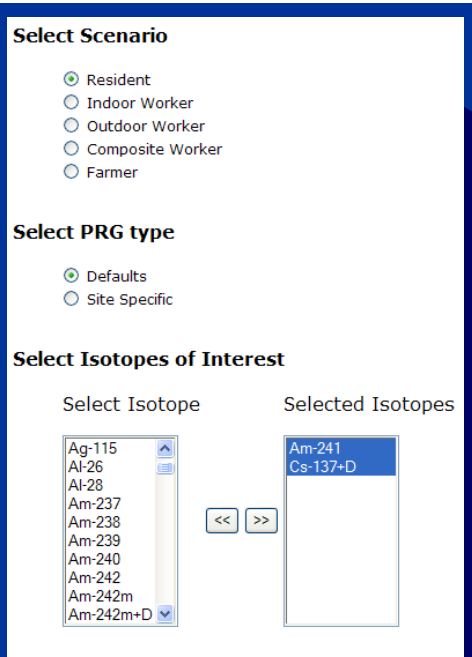
- This explanation appears in FAQ section of each PRG calculator (PRG, BPRG, SPRG)

4. **How do PRGs differ from Removal Action Levels (RALs)?**

Risk-based RALs for carcinogens generally are based on a 1 × 10-4 cancer risk. RALs typically are used to help define areas, contaminants and conditions that may warrant an emergency or a time-critical removal action at a site. To develop RALs based on the PRG calculator, we recommend either (1) multiply the PRG results from either the tables on the PRG "Download" page or the default option for the PRG "Search" page by 100; or, (2) select the site-specific on the PRG "Search" page and change the TR (target cancer risk) to 1.0E-4. Most of the radionuclides under the Soil to Groundwater scenario use MCLs as a target protective level so these two methods for adjusting PRG results would not apply.

Generic PRG run approach

- Run PRG calculator with default settings



Generic PRG run approach, cont

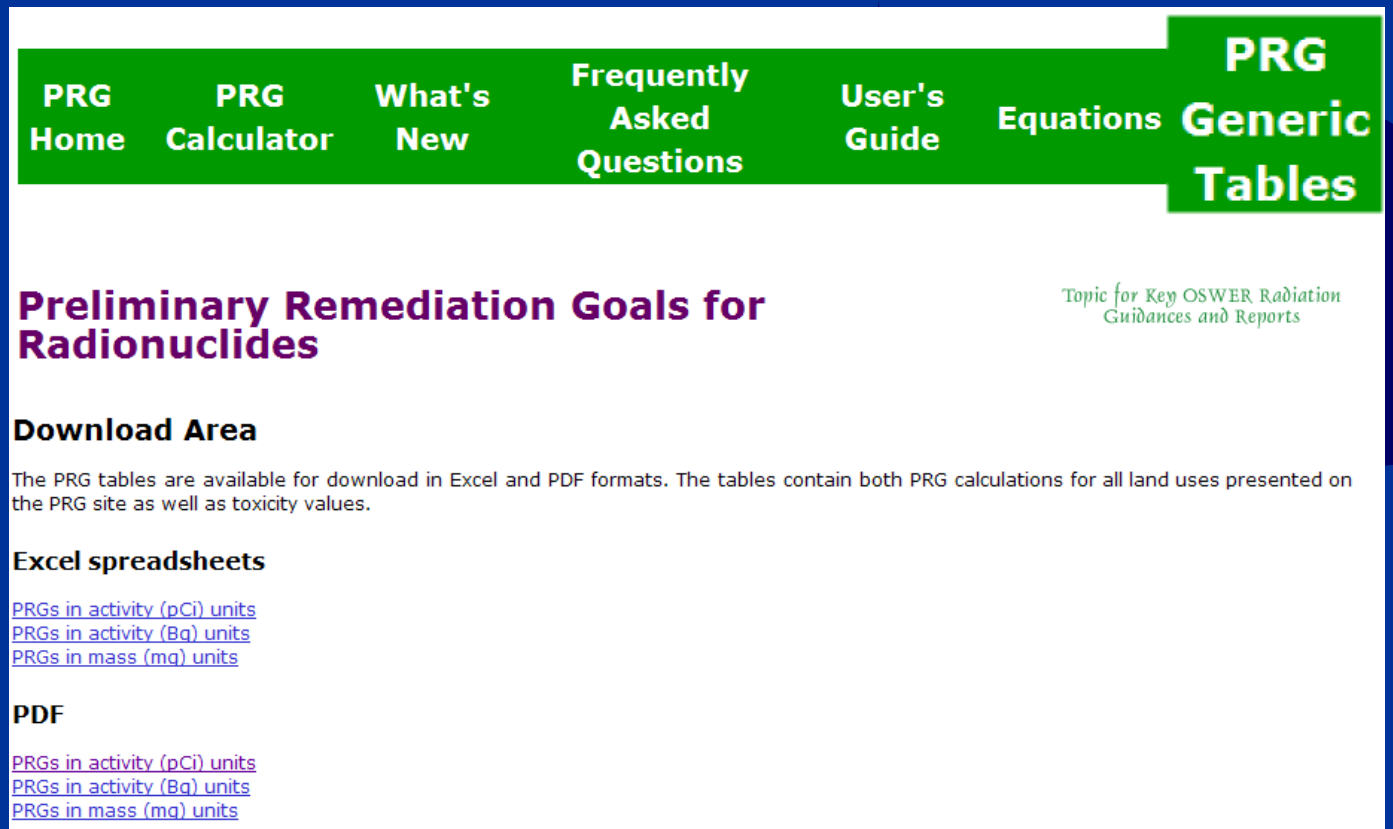
- Multiple results by 100
  - Am-241 PRG of 1.86E+00 becomes RAL of 1.86E+02
  - Cs-137 PRG of 5.99E-02 becomes RAL of 5.99E+00

Default
Resident PRGs for Soil

Isotope	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/yr per pCi/g)	Food Slope Factor (risk/pCi)	Soil Ingestion Slope Factor (risk/pCi)	Volatilization Factor (m^3/kg)	Particulate Emission Factor (m^3/kg)	Lambda	Wet Soil-to-plant transfer factor	Ingestion PRG (pCi/g)	Inhalation PRG (pCi/g)	External Exposure PRG (pCi/g)	Produce Ingestion PRG (pCi/g)	Total PRG (pCi/g)
Am-241	2.81E-08	2.76E-08	1.34E-10	2.17E-10	-	1.36E+09	1.60E-03	1.00E-03	3.75E+00	2.62E+02	4.14E+00	4.00E+01	1.86E+00
Cs-137+D	1.19E-11	2.54E-06	3.74E-11	4.33E-11	-	1.36E+09	2.31E-02	4.00E-02	2.54E+01	8.38E+05	6.08E-02	4.85E+00	5.99E-02

Generic Tables approach

- Click on PRG Generic Tables
- Click on Appropriate Table



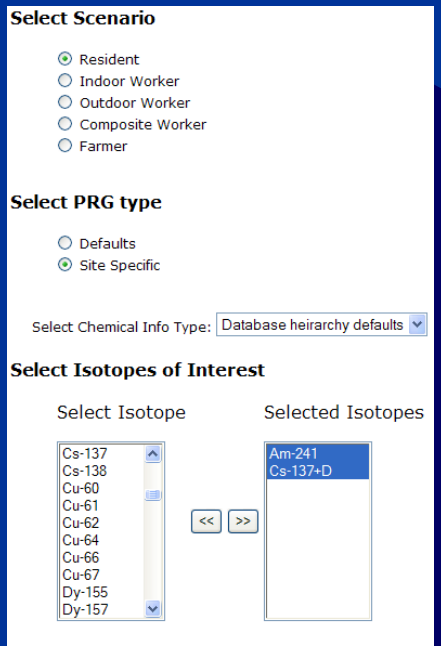
Generic Tables approach, cont

- Pick radionuclides
- Multiply by 100

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	Preliminary Remediation Goals (PRG): Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Actinium (89)	Ac-223						1.55E-08	3.58E+07	3.58E+07	5.83E+07	1.31E+08				
Actinium (89)	Ac-224	1.53E-11	2.77E-12	5.59E-12	8.03E-12	4.07E-10	6.06E-07	1.15E+04	1.15E+04	1.89E+04	4.24E+04	8.52E+00	2.20E-01		
Actinium (89)	Ac-225	5.18E-10	9.03E-11	1.89E-10	2.71E-10	2.86E-08	4.50E-08	6.36E+02	4.77E+02	2.44E+03	5.23E+03	2.52E-01	6.51E-03		
Actinium (89)	Ac-226	2.00E-10	2.84E-11	6.92E-11	1.01E-10	4.33E-09	4.46E-07	1.46E+03	1.41E+03	2.54E+03	5.71E+03	6.88E-01	1.75E-02		
Actinium (89)	Ac-227	3.81E-10	2.01E-10	2.01E-10	2.45E-10	1.49E-07	3.48E-10	2.53E+00	1.35E+00	1.14E+01	2.10E+01	2.37E-01	7.20E-03		
Actinium (89)	Ac-227+D	1.16E-09	3.45E-10	4.86E-10	6.53E-10	2.09E-07	1.47E-06	1.04E-01	8.31E-02	2.09E-01	4.67E-01	9.80E-02	2.70E-03		
Actinium (89)	Ac-228	5.55E-12	9.10E-13	1.99E-12	2.89E-12	4.92E-11	4.53E-06	7.32E+02	7.31E+02	1.19E+03	2.69E+03	2.39E+01	6.10E-01		
Aluminum (13)	Al-26	4.70E-11	8.18E-12	1.73E-11	2.49E-11	6.92E-11	1.33E-05	8.38E-03	6.28E-03	1.64E-02	3.70E-02	2.75E+00	7.08E-02		
Aluminum (13)	Al-28						9.32E-06	5.84E+04	5.84E+04	9.53E+04	2.14E+05				
Americium (95)	Am-237	1.24E-13	3.12E-14	5.07E-14	7.18E-14	5.77E-14	1.35E-06	1.24E+04	1.23E+04	2.02E+04	4.54E+04	9.39E+02	2.46E+01	3.54E+12	1.77E+11
Americium (95)	Am-238	2.28E-13	5.96E-14	9.62E-14	1.35E-13	9.51E-14	4.02E-06	3.09E+03	3.09E+03	5.05E+03	1.14E+04	4.95E+02	1.31E+01	1.03E+12	5.17E+10
Americium (95)	Am-239	3.89E-12	5.99E-13	1.38E-12	2.01E-12	8.40E-13	6.91E-07	2.47E+03	2.16E+03	4.03E+03	9.07E+03	3.45E+01	8.77E-01	1.36E+09	6.79E+07
Americium (95)	Am-240	6.81E-12	1.27E-12	2.59E-12	3.70E-12	1.41E-12	4.69E-06	8.53E+01	8.21E+01	1.39E+02	3.13E+02	1.84E+01	4.77E-01	3.97E+07	1.98E+06
Americium (95)	Am-241	2.17E-10	9.10E-11	1.04E-10	1.34E-10	2.81E-08	2.76E-08	1.87E+00	1.32E-02	5.67E+00	1.19E+01	4.58E-01	1.32E-02	2.58E+00	1.29E-01
Americium (95)	Am-242	5.14E-12	7.51E-13	1.79E-12	2.62E-12	5.03E-11	3.48E-08	3.57E+04	7.82E+03	5.94E+04	1.34E+05	2.66E+01	6.73E-01	5.79E+08	2.90E+07

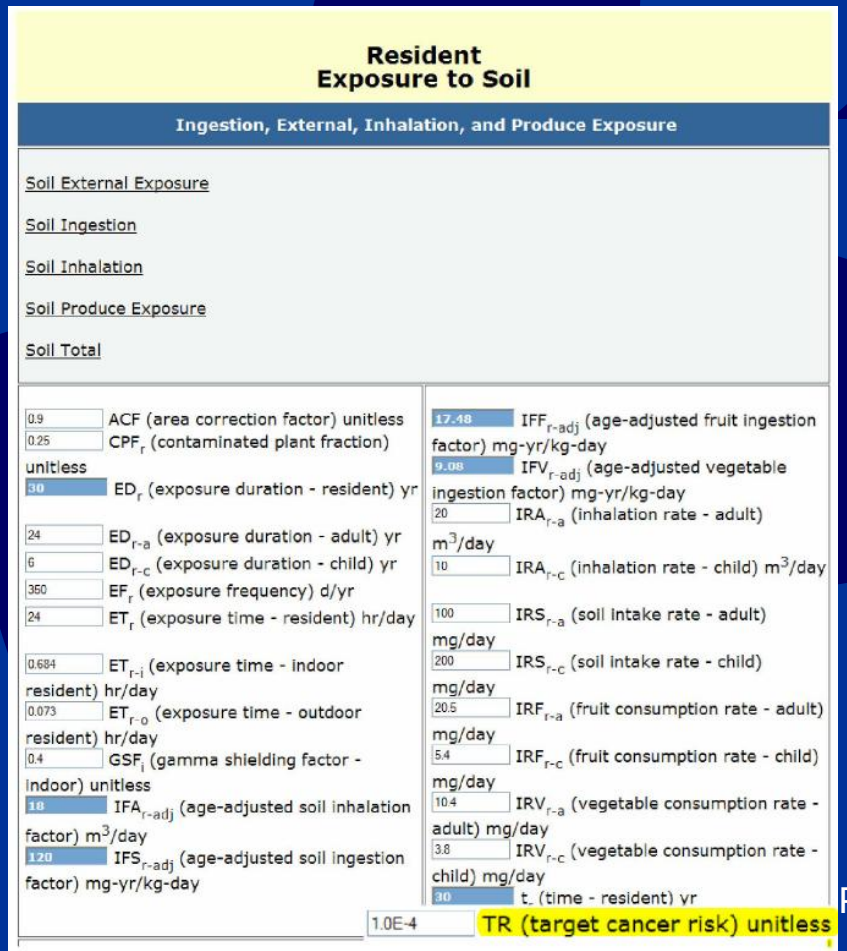
Target Risk Approach

- Run the calculator with “Site-Specific” option



Target Risk Approach, cont

- Change Default Target risk to $1x10^{-4}$



Resident
Exposure to Soil

Ingestion, External, Inhalation, and Produce Exposure

Soil External Exposure

Soil Ingestion

Soil Inhalation

Soil Produce Exposure

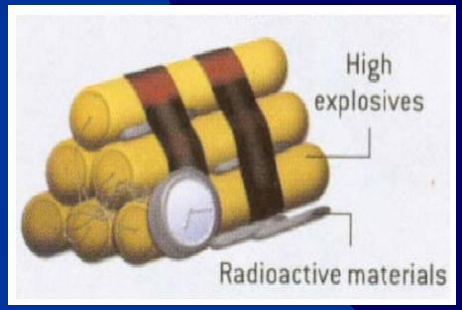
Soil Total

0.9 ACF (area correction factor) unitless	17.48 IFF_{r-adj} (age-adjusted fruit ingestion factor) mg-yr/kg-day
0.25 CPF_r (contaminated plant fraction) unitless	9.08 IFV_{r-adj} (age-adjusted vegetable ingestion factor) mg-yr/kg-day
30 ED_r (exposure duration - resident) yr	20 IRA_{r-a} (inhalation rate - adult) m^3/day
24 ED_{r-a} (exposure duration - adult) yr	10 IRA_{r-c} (inhalation rate - child) m^3/day
6 ED_{r-c} (exposure duration - child) yr	100 IRS_{r-a} (soil intake rate - adult) mg/day
350 EF_r (exposure frequency) d/yr	200 IRS_{r-c} (soil intake rate - child) mg/day
24 ET_r (exposure time - resident) hr/day	20.5 IRF_{r-a} (fruit consumption rate - adult) mg/day
0.684 ET_{r-i} (exposure time - indoor resident) hr/day	5.4 IRF_{r-c} (fruit consumption rate - child) mg/day
0.073 ET_{r-o} (exposure time - outdoor resident) hr/day	10.4 IRV_{r-a} (vegetable consumption rate - adult) mg/day
0.4 GSF_i (gamma shielding factor - indoor) unitless	3.8 IRV_{r-c} (vegetable consumption rate - child) mg/day
18 IFA_{r-adj} (age-adjusted soil inhalation factor) m^3/day	30 t_r (time - resident) yr
120 IFS_{r-adj} (age-adjusted soil ingestion factor) mg-yr/kg-day	
	1.0E-4 TR (target cancer risk) unitless

Caveats

- PRG soil to groundwater scenario, usually based on MCL protection so multiplying by 100 not appropriate
- BPRG site-specific approach will require user to pick a room size and receptor location
- SPRG state-specific approach will require user to pick state and roadway class
- SPRG site-specific approach will require user to pick building heights, receptor location, slab size, and input lots of data on car and truck traffic.

3. Using PRG and DCC Calculators for RDDs and INDs



EPA

DHS PAG

- Department of Homeland Security (DHS) in 2008 issued guidance on responses to radiological and nuclear terrorist incidents
  - »"Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incident."

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DEPARTMENT OF HOMELAND SECURITY

Federal Emergency Management Agency

[FEMA–1768–DR]

Texas; Major Disaster and Related Determinations

AGENCY: Federal Emergency Management Agency, DHS.

ACTION: Notice.

SUMMARY: This is a notice of the Presidential declaration of a major disaster for the State of Texas (FEMA–1768–DR), dated July 24, 2008, and related determinations.

DATES: Effective Date: July 24, 2008.

FOR FURTHER INFORMATION CONTACT: Peggy Miller, Disaster Assistance Directorate, Federal Emergency Management Agency, Washington, DC 20472, (202) 646–2705.

SUPPLEMENTARY INFORMATION: Notice is hereby given that, in a letter dated July 24, 2008, the President declared a major disaster under the authority of the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5121–5206 (the Stafford Act), as follows:

I have determined that the damage in certain areas of the State of Texas resulting from Hurricane Dolly beginning on July 22, 2008, and continuing, is of sufficient severity and magnitude to warrant a major disaster declaration under the Robert T. Stafford Disaster Relief and Emergency Assistance Act, 42 U.S.C. 5121–5206 (the Stafford Act). Therefore, I declare that such a major disaster exists in the State of Texas.

In order to provide Federal assistance, you are hereby authorized to allocate from funds available for these purposes such amounts as you find necessary for Federal disaster assistance and administrative expenses.

You are authorized to provide assistance for debris removal and emergency protective measures (Categories A and B), including direct Federal assistance, under the Public Assistance program in the designated areas. Federal funds provided throughout the State and any other forms of assistance under the Stafford Act that you may deem appropriate. Consistent with the Preliminary Damage Assessment (PDAs), unless you determine that the incident is of such unusual severity and magnitude that PDAs are not required to determine the need for supplemental Federal assistance pursuant to 44 CFR 206.48(b).

Consistent with the requirement that Federal assistance be supplemental, any Federal funds provided under the Stafford Act for Public Assistance and Hazard Mitigation will be limited to 75 percent of the total eligible costs, except for any particular projects that are eligible for a higher Federal cost-sharing percentage under the Public Assistance Pilot Program authorized pursuant to 6 U.S.C. 777. If Other Needs Assistance is later warranted, Federal funding under that program will also be limited to 75 percent of the total eligible costs.

Further, you are authorized to make changes to this declaration to the extent allowable under the Stafford Act.

The Federal Emergency Management Agency (FEMA) hereby gives notice that pursuant to the authority vested in the Administrator, Department of Homeland Security, under Executive Order 12148, as amended, Peggy Miller, of FEMA is appointed to act as the Federal Coordinating Officer for this declared disaster.

I do hereby determine the following areas of the State of Texas to have been affected adversely by this declared major disaster:

Aransas, Bexar, Brooks, Calhoun, Cameron, Hidalgo, Jim Wells, Kenedy, Kleberg, Nueces, Refugio, San Patricio, Starr, Victoria, Willacy Counties for Public Assistance Category B (emergency protective measures), including direct Federal assistance.

All counties within the State of Nebraska are eligible to apply for assistance under the Hazard Mitigation Grant Program.

(The following Catalog of Federal Domestic Assistance Numbers (CFDA) are to be used for reporting and drawing funds: 97.030, Community Disaster Loans; 97.031, Cora Brown Fund; 97.032, Crisis Counseling; 97.033, Disaster Legal Services; 97.034, Disaster Unemployment Assistance (DUA); 97.046, Fire Management Assistance Grant; 97.048, Disaster Housing Assistance to Individuals and Households In Presidentially Declared Disaster Areas; 97.049, Presidentially Declared Disaster Assistance—Disaster Housing Operations for Individuals and Households; 97.050 Presidentially Declared Disaster Assistance to Individuals and Households—Other Needs; 97.036, Public Assistance (Presidentially Declared Disaster); 97.039, Hazard Mitigation Grant.)

R. David Paulison,
Administrator, Federal Emergency Management Agency.

[FR Doc. E8–17600 Filed 7–31–08; 8:45 am]

BILLING CODE 9110–10–P

DEPARTMENT OF HOMELAND SECURITY

Federal Emergency Management Agency

[Docket ID FEMA–1768–0004]

[Z–RIN 1660–ZA32]

Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents

AGENCY: Federal Emergency Management Agency, DHS.

ACTION: Notice of final guidance.

SUMMARY: The Department of Homeland Security (DHS) is publishing guidance entitled, "Planning Guidance for Protection and Recovery Following Radiological Dispersal Device (RDD) and Improvised Nuclear Device (IND) Incidents" (hereinafter, "Guidance"). Guidance is intended for Federal agencies, State and local governments, and other organizations that may help the general public who should find it useful in developing plans for responding to an RDD or IND incident. The Guidance recommends "protective action guides" to help officials make decisions about actions that should be taken to protect the public and emergency workers when responding to or recovering from an RDD or IND incident. The Guidance also outlines a process to implement the recommendations, discusses existing operational guidelines that should be useful in the implementation of the Guidance, and identifies areas that will encourage federal, state and local emergency response officials to use these guidelines to develop specific operational plans and response capabilities. Finally, the Guidance encourages workers responding to catastrophic incidents involving high levels of radiation and/or radioactive contamination.

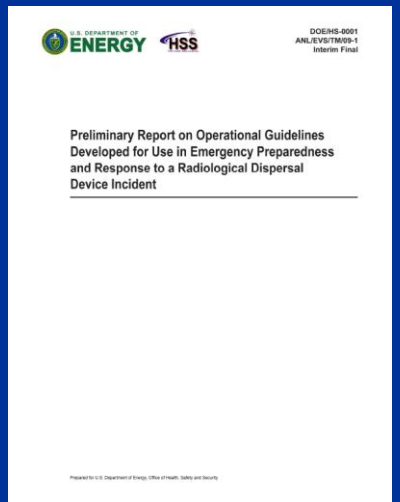
DATES: This notice is effective August 1, 2008.

FOR FURTHER INFORMATION CONTACT: Eric Godkin, Director (acting), Specific Agency Executive Management Office, Office of Infrastructure Protection,

PHASE	PROTECTIVE ACTION	DHS RDD/IND PROTECTIVE ACTION GUIDE
Early	Limit Emergency Worker Exposure	Normally 5 rems, higher values under emergency circumstances as needed
	Sheltering of Public	1 to 5 rem projected dose, normally initiated at 1 rem
	Evacuation of Public	1 to 5 rem projected dose, normally initiated at 1 rem
	Administration of Prophylactic Drugs	For KI, FDA Guidance dose values. For other drugs, consider on an ad hoc basis
Intermediate	Limit Worker Exposure	5 rems in compliance with OSHA regulations
	Relocation of General Public	2 rems, projected dose 1st Year
		Any subsequent year: 500 mrem projected dose
	Food Interdiction	500 mrem projected dose
	Drinking Water Interdiction	500 mrem dose
Late	Final cleanup actions	Site specific level based on Optimization

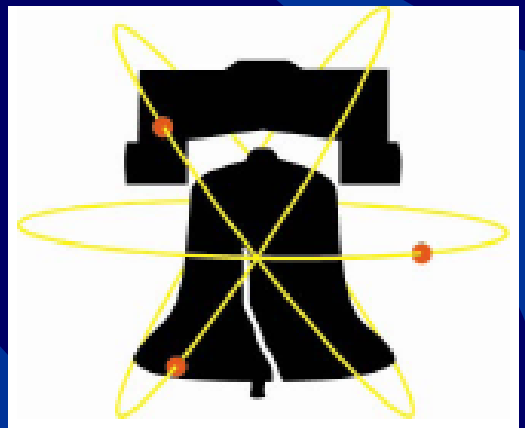
DHS PAG: Early and Intermediate Phase

- DHS PAG envisions using DOE Operational Guidelines for early and intermediate phases
  - However, at Liberty RadEx, Pennsylvania used concentrations from DOE and EPA (DCC, BDCC, and SDCC) model runs for relocation concentrations


U.S. DEPARTMENT OF ENERGY HSS

DOE/HS-0001
ANL/EVS/TM/09-1
Interim Final

Preliminary Report on Operational Guidelines Developed for Use in Emergency Preparedness and Response to a Radiological Dispersal Device Incident



EPA CERCLA-like Approach may be used under Optimization

- 10^{-4} to 10^{-6} or higher risk levels
  - May consider risk levels outside CERCLA risk range (10^{-3}, 10^{-2})
- ARARs
- NCP 9 criteria
- OSWER directives and tools
  - **Including PRG, BPRG, and SPRG calculators**

Using PRG/DCC Calculators for RDD/IND Events

- Just like CERCLA sites:
  - Defaults in PRG/DCC calculators may be modified with site-specific information
  - Site managers should weigh cost of collecting data against utility of generating site-specific PRGs

Using PRG/DCC Calculators for RDD/IND Exercises

- To use calculators for a risk assessment for exercises, some assumptions should be made.
- Following pages discuss several key assumptions that would generally be made for exercises.
- Some of these exercise assumptions require additional spreadsheet work outside of calculator.

RDD/IND Exercise Assumptions – Outdoor Resuspension of Dust

- Change windblown resuspension rates to match area of the country of exercise (not Minneapolis default)
- SPRG/SDCC dust on streets scenario, change to correct state and roadway class for mechanical resuspension (not urban California highway default)

EPA

RDD/IND Exercise Assumption – Intrusion Indoors of Contaminants

- In areas where public is relocated, I assume 50% based on studies of 2 buildings near WTC ground zero
- In areas where public is not relocated, I assume 2 times value based on study of indoor dust at contaminated sites

RDD/IND Exercise Assumptions – Indoor Resuspension Rate

- EPA policy with WTC event and BPRG calculator is not to model resuspension indoors, should be measured not modelled.
- For exercises I have used rate of 1×10^{-4} m^{-1} based on Los Alamos and NAS reports.

RDD/IND Exercise Assumptions – Weathering away of contaminants

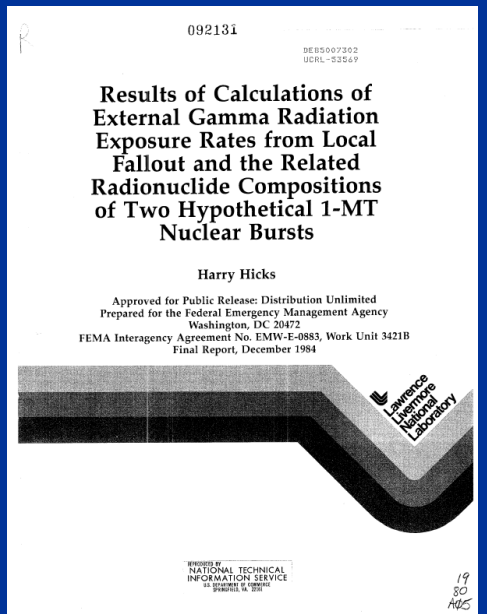
- NARAC plume maps for PAG dose recommendations assume a weathering rate
- To develop similar risk-based plumes, need to:
  - » factor in amount of weathering that would take place to reach risk-based contours, then
  - » plot initial deposition that would result in risk-based levels in ## days

IND Fallout Challenges for Risk Assessment

- Initial IND detonation includes over 900 radionuclides
- 1 year after detonation, almost all risk posed by 38 radionuclides.

Solving IND Fallout Challenge

- Data is available on the mix of those 38 radionuclides for 10 time periods ranging from 1 to 50 years



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Results of Calculations of External Gamma Radiation Exposure Rates from Local Fallout and the Related Radionuclide Compositions of Two Hypothetical 1-MT Nuclear Bursts

Harry Hicks

Approved for Public Release: Distribution Unlimited
Prepared for the Federal Emergency Management Agency
Washington, DC 20472
FEMA Interagency Agreement No. EMW-E-0883, Work Unit 3421B
Final Report, December 1984

Lawrence Livermore National Laboratory

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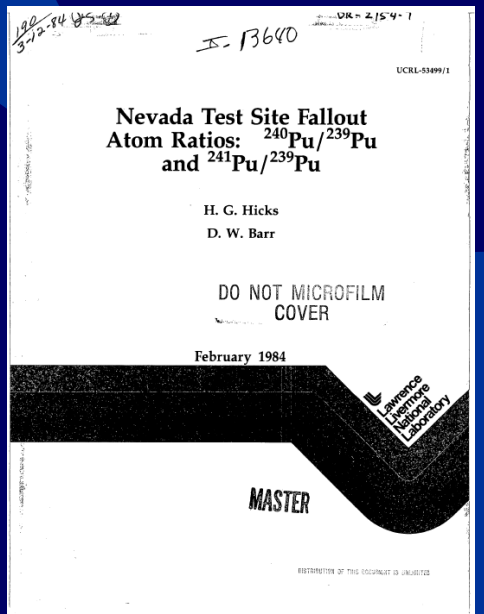

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UCRL-53499/1

Nevada Test Site Fallout Atom Ratios: $^{240}Pu/^{239}Pu$ and $^{241}Pu/^{239}Pu$

H. G. Hicks
D. W. Barr

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COVER

February 1984

Lawrence Livermore National Laboratory

MASTER

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Solving IND Fallout Challenge, continued

- Mix depends on if:
  - U-235 or U238 is fissionable material
  - Debris either unfractionated, or either 0.5 or 0.1 of refractory elements present

Solving IND Fallout Challenge, Implementation

- Develop ratio of concentration of Cs-137 to 37 radionuclides
  - » NARAC can model concentrations of Cs-137 for IND
- Run risk assessment with Superfund methodology to determine what % of total risk is from Cs-137 for a given land use

Solving IND Fallout Challenge, Done

- If Cs-137 is 5% of total cancer risk from IND mix at year 1, and 100 pCi/cm^2 of Cs-137 = 1 x 10^{-4}, then the 1 x 10^{-4} plume contour line will be based on 5 pCi/cm^2 of Cs-137

For More Information

For further information or questions:

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Questions